Ultrafast Energy Transfer in Fluorescent Organic Nanoparticles

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Fluorescent markers with high brightness, photostability and biocompatibility are in high demand for fluorescence imaging. It is an attractive way to construct fluorescent nanoparticles (NPs) based on organic dyes for bioimaging. However, it is hampered by the aggregation-caused quenching. The recently created SMILES approach (Figure 1a)[1] that solves the problem of aggregation-caused quenching by organizing dyes into densely packed structures while keeping their attractive optical properties. We have used the SMEILS approach to develop biocompatible NPs with high brightness. [2]

The ultrafast energy transfer process is widely present in such organic dye based fluorescent NPs, which can cause fluorescence quenching due to the presence of defects in NPs. However, the energy transfer process also can be utilized to enhance NPs' fluorescence and tune their optical properties. Herein, we use such energy transfer process to tune the NPs' emission colors, lifetimes[3] and brightness. Furthermore, we studied the energy transfer processes with femtosecond (*fs*) transient absorption spectroscopy, [4] in which we found the energy transfer can happen at few hundreds *fs* to tens *ps*.

Figure 1: (a) small-molecule ionic isolation lattices (SMILES) structure, blue: energy donor, green: energy acceptor; (b) SMILES NPs with different emission color under 365 light illumination; (c) *fs* transient absorption decay traces monitored at energy acceptor in SMILES NPs.

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